Outbreak of Influenza and Rhinovirus Co-circulation Among Unvaccinated Recruits, U.S. Coast Guard Training Center Cape May, NJ, 24 July–21 August 2016

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Military and Coast Guard recruits are particularly susceptible to respiratory infections. Although seasonal influenza vaccinations are mandatory for recruits, the vaccine expires annually in June. On 29 July 2016, the U.S. Coast Guard Training Center Cape May, NJ, identified an increase in febrile respiratory illness (FRI) among recruits. During 24 July–21 August, a total of 115 recruits reported symptoms. A total of 74 recruits tested positive for respiratory infections: influenza A (H3) (n=34), rhinovirus (n=28), influenza/rhinovirus co-infection (n=11), and adenovirus/rhinovirus co-infection (n=1), while 41 recruits had no laboratory-confirmed specimen but were considered suspected cases. Only one recruit reported receiving the seasonal influenza vaccine within the previous 12 months. Influenza predominated during 24 July–6 August, whereas rhinovirus predominated during 7 August–20 August. Most (92.2%) cases were identified in four of 10 recruit companies; incidence rates were highest among recruits in weeks 2–4 of an 8-week training cycle. Key factors for outbreak control included rapid detection through routine FRI surveillance, quick decision-making and streamlined response by using a single chain of command, and employing both nonpharmaceutical and pharmaceutical interventions.

In 2016, respiratory infections affected more than 250,000 U.S. service members and comprised approximately 22% of medical encounters among military recruit populations.[1,2] Seasonal influenza and rhinovirus are two of the leading respiratory pathogens of major military concern in terms of incidence and operational impact.[3] Although incidence of seasonal influenza typically peaks during the winter and spring months in the Northern Hemisphere, illness caused by rhinovirus remains a persistent threat throughout the year among recruit trainee populations.[4]

Military recruits are highly susceptible to respiratory infections. This susceptibility is largely attributed to factors associated with a shared, closed environment; greater-than-usual social proximity; and physical and mental stress during training.[3,5,6] To mitigate these factors, mandatory vaccinations, including seasonal influenza, are administered routinely to all incoming recruits in addition to other active duty personnel.[7] However, variations in seasonal influenza vaccine effectiveness and coverage can lead to gaps in immunity. Additionally, the vaccine expires each year in June, while the following season's vaccine is not available until late summer;[7-9] therefore, incoming recruits who begin training during summer months do not receive the seasonal influenza vaccine. Currently, there are no licensed vaccines for rhinovirus.[3] Although proper hygiene and routine disease prevention measures should be instituted year-round, additional mitigation and control strategies, such as chemoprophylaxis and nonpharmaceutical interventions, can mitigate outbreak severity when implemented during an outbreak even in the absence of a vaccine.[3,10,11]

The U.S. Coast Guard (USCG) Training Center Cape May (TCCM), NJ, is the only USCG recruit training center and the fifth largest USCG installation. Training cycles typically last 8 weeks, and approximately 4,250 recruits graduate each year. During any given week, approximately 700 recruits in seven to eight companies are present at the training center. TCCM is overseen by one commander with a single chain of command for the various functions, including the facilities division, administrative support division, training division, and medical division, to ensure mission success. The on-site health clinic includes a 21-bed patient care unit for recruits requiring overnight treatment.

TCCM participates as a Department of Defense febrile respiratory illness (FRI) sentinel surveillance site.[12] The training center collects nasal swab specimens for FRI patients and sends them for laboratory testing and characterization at the Naval Health Research Center (NHRC) in San Diego, CA. TCCM typically reports three to four FRI patients per week, and isolation protocols have been established for controlling disease spread. On 29 July 2016, the clinic identified an increase in the number of recruits presenting with FRI. This report characterizes the outbreak and containment measures implemented at TCCM during 24 July–21 August 2016.

METHODS

During the outbreak, two case classifications were used: 1) FRI cases, defined as persons with a fever of 100.4°F or greater and respiratory symptoms; and 2) upper respiratory illness (URI) cases, defined as persons with a temperature between 98.6°F and 100.4°F and respiratory symptoms. Documented signs and symptoms were based on a combination of self-reports and medical examinations, and included pneumonia, sore throat, cough, shortness of breath, congestion, headache, pink eye, body aches, and fever.

Clinic logs from TCCM and laboratory results from NHRC were used to analyze case information collected during 24 July–21 August 2016, the period during which case numbers increased above the baseline rate of 0.4 FRI cases/100 trainees/week to a rate of 2.8 cases/100 trainees/week. Individuals presenting with FRI or URI who had a positive laboratory specimen by polymerase chain reaction (PCR) were classified as confirmed cases, while those without a positive laboratory specimen (either no specimen collected or no pathogen detected) were classified as suspected cases.

The following variables were analyzed: specimen collection date, clinic admission and discharge dates, final laboratory diagnosis, training company assignment, seasonal influenza vaccination status, sex, and symptom types. Seasonal influenza vaccination status was based on self-reports of vaccination within the previous 12 months because influenza vaccination records were often unavailable. The training week (1–8) at the time of specimen collection or admission date was determined for each case. Lost duty time was assessed using duration of clinic admission, and light duty time was assessed using days of restricted training following medical discharge.

Average weekly recruit populations were calculated for each company and training week. The total numbers of confirmed and suspected cases were divided by the average weekly recruit populations to calculate incidence rates by company and by training week. Incidence rates also were calculated using only confirmed cases.

Quantitative and qualitative data regarding outbreak response activities were collected from TCCM staff using email and unstructured interviews. Outbreak interventions were classified as either pharmaceutical or nonpharmaceutical. The number of persons who were screened for symptoms and received prophylaxis through a point-of-dispensing (POD) was determined by using available paper documentation from two PODs implemented on 5 and 16 August 2016.

RESULTS

Data were analyzed for 115 confirmed and suspected cases detected during the outbreak period during 24 July–21 August 2016. Of these, 74 (64.3%) were classified as confirmed cases and 41 (35.7%) were classified as suspected cases. Among confirmed cases, nearly half of the laboratory specimens tested positive for influenza A (H3) (n=34; 45.9%), followed by rhinovirus (n=28; 37.8%), influenza A (H3) and rhinovirus co-infection (n=11; 14.9%), and rhinovirus and adenovirus co-infection (n=1; 1.4%). Gene sequencing of the positive influenza specimens showed that the circulating influenza strain belonged to the subclade 3C.2a, which was not included in the 2015–2016 influenza vaccine composition.[13] Among suspected cases, 22 (53.7%) had no pathogen detected and 19 (46.3%) had no specimen available for laboratory testing.

No cases were identified among nonrecruits, and only one of the 73 (1.4%) confirmed cases who had available seasonal vaccine status information had received the vaccine within the previous 12 months. A total of 16 (13.9%) patients were female, which is consistent with the distribution of the recruit population **(data not shown)**. Overall, the outbreak resulted in at least 373 person-days of lost duty time in addition to 91 person-days of light duty time **(data not shown)**.

Overall, the outbreak showed a bimodal distribution, with a peak during 31 July–6 August and a smaller peak during 14–20 August **(Figure 1)**. However, influenza A (H3) infections predominated during 24 July–6 August, particularly in Companies B and C, whereas rhinovirus predominated during 7 August–20 August, particularly in Companies D and E **(data not shown)**. Additionally, 91.6% of co-infections occurred during 24 July–6 August **(Figure 1)**.

Seven of 10 (70.0%) recruit companies reported either confirmed or suspected cases, and five companies (50.0%) reported at least one confirmed case **(Table 1)**. Company C accounted for the most cases (n=41) and had the highest overall incidence rate (46.1%), followed by Companies B (25.0%) and E (22.9%); however, incidence rates for confirmed cases only were highest among Companies B and C.

Incidence rates were highest among recruits in training weeks 2–4 **(Table 1)**. Similarly, the highest proportion of influenza A (H3) infections, rhinovirus infections, co-infections, and suspected cases, respectively, were among recruits in these training weeks. Conversely, no confirmed cases and only two suspected cases were among recruits in training weeks 6–8.

Among cases with available information (n= 95), the following symptoms were identified through self-report or medical examination upon presentation at the clinic: cough (87 of 95, 91.6%), sore throat (87 of 95, 91.6%), congestion (83 of 94, 88.3%), fever (75 of 106, 70.8%), headache (56 of 94, 59.6%), nausea (27 of 95, 28.4%), shortness of breath (18 of 94, 19.1%), conjunctivitis (5 of 93, 5.4%), and diagnosed pneumonia (2 of 95, 2.1%).

Table 2 details the nonpharmaceutical and pharmaceutical interventions that were implemented to control the outbreak, encompassing three main components: 1) screening and isolation, 2) enhanced hygiene and social distancing, and 3) treatment and prophylaxis. **Figure 2** depicts the timeline of these interventions, along with key events pertaining to laboratory diagnostic testing. Screening and isolation and enhanced hygiene and social distancing measures were implemented within the first 24 hours upon recognition of the outbreak, even before the receipt of positive rapid influenza diagnostic test results. Tamiflu® (oseltamivir) treatment (75 mg twice daily for 5 days) was initiated immediately, and

TABLE 1. Numbers of confirmed and suspected cases and incidence rates, by recruit company and training week, U.S. Coast Guard Training Center Cape May, NJ, 24 July–21 August 2016

		Total cases		Confirmed cases						Suspected cases	
	Average weekly recruit population	No. cases N=115	Incidence rate[a]	Influenza A (H3) N=34		Rhinovirus N=28		Co-infection[b] N=12		N=41	
Recruit company	N	N		N	%	N	%	N	%	N	%
Company A	78	1	1.3	0	0.0	0	0.0	0	0.0	1	2.4
Company B	120	30	25.0	14	41.2	3	10.7	6	50.0	7	17.1
Company C	89	41	46.1	17	50.0	9	32.1	5	41.7	10	24.4
Company D	104	11	10.6	0	0.0	3	10.7	1	8.3	7	17.1
Company E	105	24	22.9	3	8.8	11	39.3	0	0.0	10	24.4
Company F	98	3	3.1	0	0.0	1	3.6	0	0.0	2	4.9
Company G	97	1	1.0	0	0.0	0	0.0	0	0.0	1	2.4
Company H	109	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Company I	71	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Company J	89	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Other[c]	53	4	7.5	0	0.0	1	3.6	0	0.0	3	7.3
Recruit training week[d]											
Week 1	103	3	2.9	2	5.9	0	0.0	0	0.0	1	2.6
Week 2	99	33	33.3	16	47.1	7	25.9	1	8.3	9	23.7
Week 3	101	40	39.6	3	8.8	15	55.6	4	33.3	18	47.4
Week 4	106	31	29.2	13	38.2	4	14.8	7	58.3	7	18.4
Week 5	99	2	2.0	0	0.0	1	3.7	0	0.0	1	2.6
Week 6	89	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Week 7	83	2	2.4	0	0.0	0	0.0	0	0.0	2	5.3
Week 8	81	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

[a] Rate per 100 persons. Calculated for any patients meeting the confirmed or suspected case definitions.
[b] Co-infection with influenza A (H3) and rhinovirus or adenovirus and rhinovirus
[c] Includes recruits not assigned to a training company
[d] By date of specimen collection or admission; four cases were not assigned a training week.

prophylaxis (75 mg once daily for 10–20 days) for the entire recruit regiment and staff was initiated within 48 hours of receiving positive influenza A (H3) and rhinovirus PCR test results.

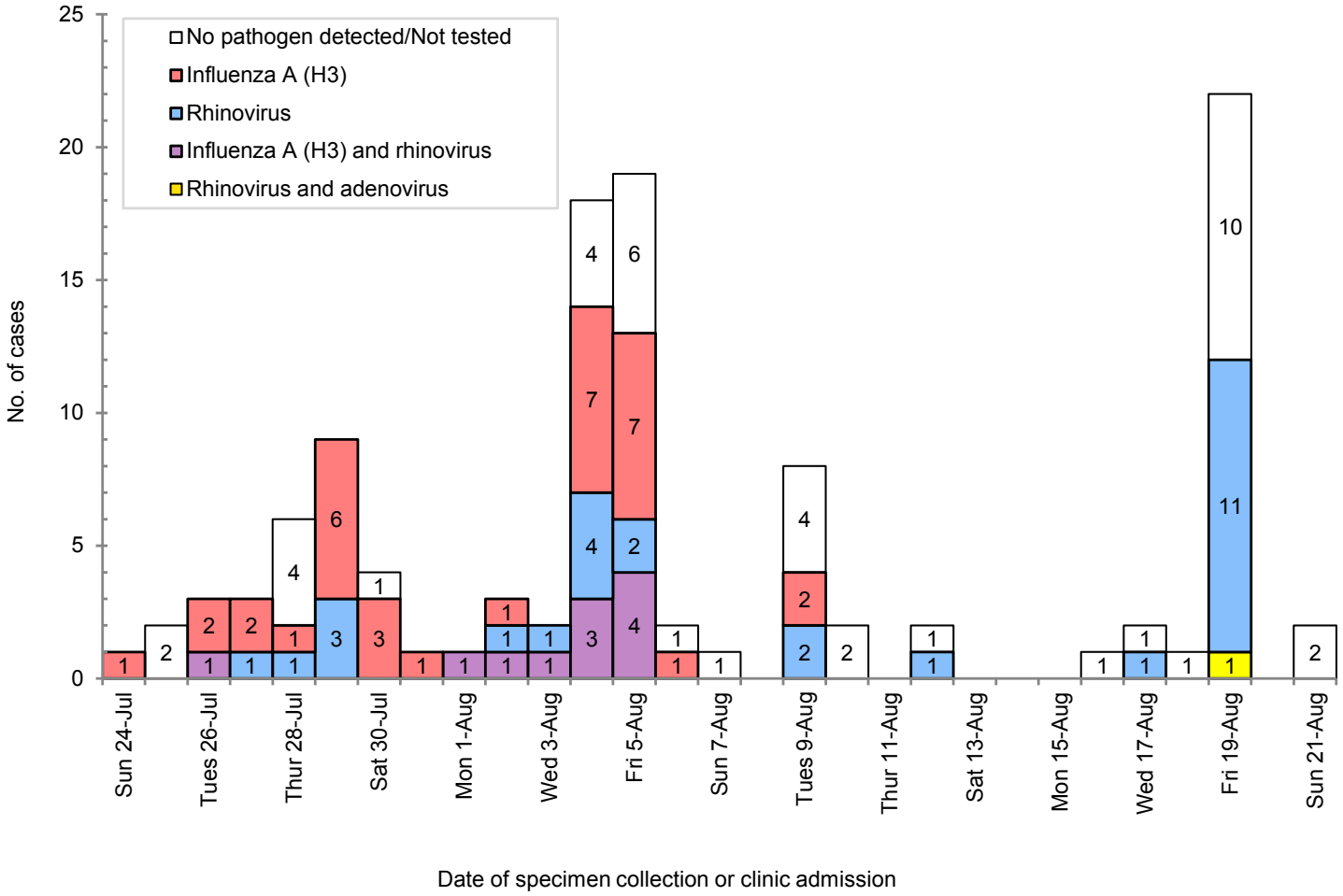
EDITORIAL COMMENT

The influenza/rhinovirus outbreak at TCCM during 24 July–21 August 2016 occurred in a recruit population that was unvaccinated against seasonal influenza as a result of the annual vaccine's expiration. The lack of vaccination, coupled with close social proximity in a high-stress environment along with a continuous influx of new recruits, likely led to lower immunity and increased risk of person-to-person transmission of both influenza and rhinovirus in this susceptible population.

The first half of the outbreak was dominated by influenza A/H3 circulation, particularly in Companies B and C. These companies were housed on different floors within the same barracks, which may have increased the chances for respiratory infections to spread. The decline in cases during 7–13 August suggested that Tamiflu and other nonpharmaceutical measures likely controlled influenza transmission **(Figure 1)**. Rhinovirus infections subsequently increased during 14–20 August, and primarily occurred within companies with incoming recruits. A total of 22 suspected cases did not have a pathogen detected, which may be related to diagnostic testing sensitivity or may occur if the specimen was collected more than 72 hours after the onset of symptoms.

Overall, most ill recruits were identified in training weeks 2–4 and no cases were confirmed among recruits in training weeks 6–8. This timing supports historical findings indicating that new recruits experienced higher incidence of acute respiratory disease,[14] potentially due to inexperienced immune systems and high stress levels, although this may vary by pathogen. Other possibilities include that the index case was in early training and had less contact with recruits in advanced training weeks, or that recruits in advanced

FIGURE 1. Numbers of outbreak-associated cases (confirmed and suspected), by laboratory diagnosis and date of specimen collection or admission, U.S. Coast Guard Training Center Cape May, NJ, 24 July–21 August 2016



training weeks were vaccinated against seasonal influenza before the vaccine expired and received some cross-protection against the circulating 3C.2a strain.

Although the outbreak significantly affected operations at TCCM, including lost duty time as well as procedural changes, a timely and comprehensive response resulted in successful containment of the outbreak within 5 weeks. Several key factors were identified as having contributed to this success. First, TCCM's participation as a FRI sentinel surveillance site enhanced its ability to quickly detect an increase in FRI patients and to request expedited laboratory testing results through established communication channels. Second, the cooperation of TCCM leadership and its single chain-of-command structure allowed for rapid decision-making and a streamlined outbreak response. This structure allowed for the operationalization of a POD for Tamiflu prophylaxis the same day that release of the stockpile was authorized, after which only three new cases of influenza were identified. Third, the immediate implementation of nonpharmaceutical interventions likely prevented widespread disease transmission at the training center and to the neighboring community, evidenced by the fact that no nonrecruits or civilians were identified as cases. Furthermore, these interventions were nonspecific to a particular etiologic agent, and presumably helped to control infections caused by multiple pathogens.

Given the potential for adverse reactions and antiviral resistance, the Centers for Disease Control and Prevention (CDC) does not recommend the widespread or routine use of Tamiflu.[15] Furthermore, targeted use of chemoprophylaxis with neuraminidase inhibitors, such as Tamiflu, is not routinely recommended for outbreaks by U.S. military officials,[3] although its use should be considered under particular circumstances. CDC guidelines for the control of influenza outbreaks in institutional settings recommends the use of antiviral chemoprophylaxis for all residents for a minimum of 2 weeks and up to 1 week after the last known case was identified.[15] In this case, TCCM had the available resources and proper justification to

TABLE 2. Nonpharmaceutical and pharmaceutical outbreak interventions, U.S. Coast Guard Training Center Cape May, NJ, 24 July–21 August 2016

Interventions	
Nonpharmaceutical	
Screening and isolation	Established separate FRI and URI wards to isolate cases.
	Conducted twice-daily temperature screenings per company (and encouraged self-reporting illness), initially within Company C and expanding to additional companies; ill recruits were sent to FRI or URI wards for isolation.
	Ensured a febrile status off medications for 24 hours prior to return to company.
	Utilized masks to prevent droplet spread.
Enhanced hygiene and social distancing	Delivered meals to FRI and URI ward patients.
	Cancelled swim, off-site liberties, reversions,[a] and motivational program.[b] Off-site liberties were replaced with alternative on-site recreational activities.
	Cancelled watch standing duties outside of assigned barracks and mandated watch standing within assigned halls/barracks to prevent transmission.
	Arranged beds in alternating head-to-toe orientation and distanced beds by 3 feet.
	Educated all recruits and staff on preventive hygiene measures.
	Instituted extra handwashing and routine use of hand sanitizers.
	Increased frequency of disinfection and sanitation of halls and facilities, as well as laundry regimen.
	Eliminated close physical contact during training and team-building activities.
Pharmaceutical	
Treatment and prophylaxis	Requested and received authorization for prophylactic use of Tamiflu® stockpile supply within 24 hours.
	Administered Tamiflu as treatment (75 mg twice daily for 5 days) for patients with symptom onset <72 hours.
	Established a closed point-of-dispensing to conduct temperature screenings and provide Tamiflu prophylaxis (75 mg once daily for 10–20 days) for recruits, staff, and the neighboring community (n=162).
	Provided Tamiflu prophylaxis (75 mg once daily for 10–20 days) to all incoming recruits during the outbreak period and conducted mop-ups for missed recruits.

FRI, febrile respiratory illness; URI, upper respiratory illness
[a]Reassigning a recruit to an earlier training week for disciplinary purposes
[b]Recruit Aptitude and Motivation Program used for disciplinary purposes

provide chemoprophylaxis to all residents; however, the duration of prophylaxis varied for individuals and may have been less than the 14-day minimum. Careful consideration should be given to the use of Tamiflu for chemoprophylaxis during outbreaks, and decisions should be made on a case-by-case basis following the appropriate guidelines.

Use of nonpharmaceutical interventions for disease control can be applied to future outbreaks, particularly in recruit populations where outbreaks are likely to occur and when a vaccine is not available or has expired. Additionally, prudent use of chemoprophylaxis may be considered. Finally, this outbreak highlights the importance of routine disease surveillance on military installations to rapidly detect and respond to disease threats.

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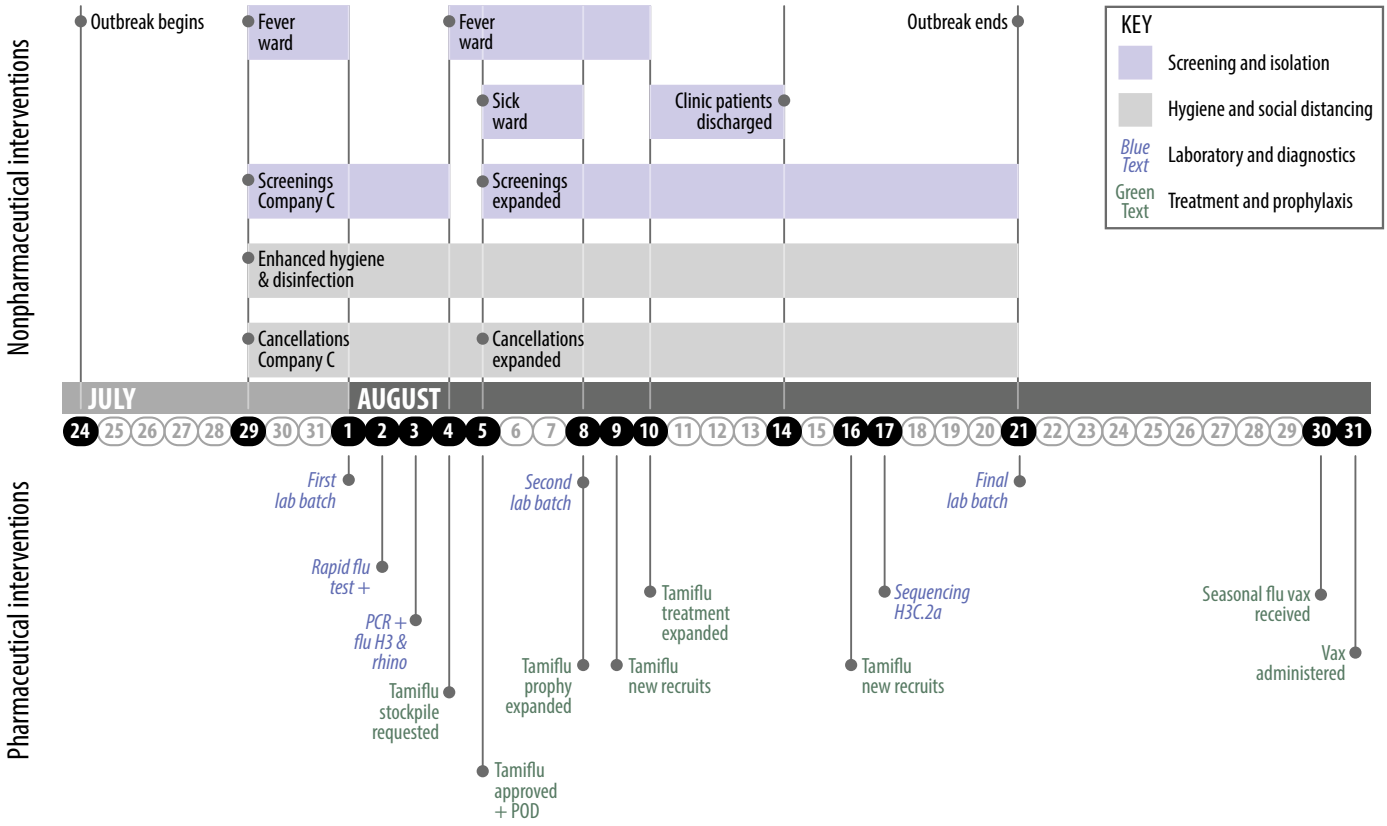
FIGURE 2. Timeline of pharmaceutical and nonpharmaceutical interventions, U.S. Coast Guard Training Center Cape May, NJ, 24 July–21 August 2016



the United States Government." Title 17, U.S.C. §101 defines a U.S. Government work as work prepared by an employee of the U.S. Government as part of that person's official duties.

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14. ABSTRACT

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